

Design, Modification & Implementation of Tilting Steering System

Shubham Namadeo Raut¹, Ketan Rajkumar Chougule², Nilesh Vijay Sabnis³

¹UG Student, Department of Mechanical Engineering, Sanjay Ghodawat Institute, Atigre, Maharashtra, INDIA

²UG, Department of Mechanical Engineering, Sanjay Ghodawat Institute, Atigre, Maharashtra, INDIA

³Assistant Professor, Department of Mechanical Engineering, Sanjay Ghodawat Institute, Atigre, Maharashtra, INDIA

ABSTRACT

In general all vehicles have a steering system in which wheels are steered to take turn. But there is a vehicle called tilting trike in which wheels are tilted instead of turning. Currently some foreign automobile companies like Toyota, Harley Davidson are working on tilt steering system. It gives some advantages like anti-skidding effect, reduced turning radius etc. But this system has its own disadvantages also e.g. it doesn't work properly at low speed. So in our project we have designed & implemented a new steering system in which both turning & tilting are possible. So we will have combined advantages of both turning & tilting.

We have successfully implemented the combination of steering systems which are capable of giving combined advantages of both the steering systems like anti-skidding effect, reduced turning radius etc. While working on this project we have focused on implementation the steering system, finding the problems opposing to implement this system & finding solutions for those problems. During this project we have designed total 5 steering systems, each time improving & making it better & better.

Keywords-- solutions, Modifications, Finding

I. INTRODUCTION

Tilting trike is a three wheeled vehicle whose body &/or wheels tilt in the direction of the turn. Such vehicles can corner safely comfortably despite having a narrow track. There are two types of tilting trike as 1:Delta Trike & 2:Tadpole Trike. Delta Trike has two wheels at the rear and one wheel at the front. It is easy to construct. Steering can be given to front wheel only and tilting can be given to two rear wheels. Tadpole trike has two wheels at the front and one wheel at the rear. The tadpole configuration with a properly centered CG provides excellent traction, turning & braking. It provides a larger tilting range & also it can be tilted further while stationary without tipping over. But it has a little difficult steering

mechanism. Both steering and tilting has to be given to the front two wheels only.

Thought tilting trike have some advantages, it has some disadvantages also. It works better only at high speed against the centrifugal force. It doesn't work properly at low speed. Suppose we want to take a sharp 'U' turn then by tilting the wheels we can take 'U' turn. But if we want to overtake the big vehicle then tilting the wheels will not be beneficial as it will tend to take 'U' turn instead of overtaking the next vehicle. So in such case we need to turn the wheels. Tilting & turning both are possible only when the vehicle has both the systems.

Both the steering systems (tilt & turn) have their own unique advantages so if both the steering systems are added then it will be more beneficial for the vehicle.

In our project of 'Modifications in tilt steering' we have designed such a steering system that can allow both tilting & turning of wheels.

II. METHODOLOGY

While doing it we went through following methods:

1. Preparing rough concepts of mechanisms that can achieve our requirements.
2. Selection of best rough concept
3. Preparing CAD models of selected concept & checking for its working animation.
4. Finding the reasons constraining the design to work.
5. Finding the solutions to those problems.
6. Making changes in design based on the solutions made for problems.
7. Checking for working animation.
8. Improving the design for best working.
9. Manufacturing & buying of parts required for implementation of our design.
10. Assembly of all parts & components.
11. Dynamic tests on vehicle
12. From beginning to final, we made total five designs. Among them we selected best suitable design.

III. PRIOR APPROACH

Today we only turn wheels of our vehicle for taking turn. This regular steering system has some disadvantages like

1. It cannot provide sharp turning.
2. It has larger turning radius.
3. Vehicle may topple if speed of the vehicle while taking turn is too high (It means you must have to reduce speed of your vehicle while taking turn).
4. Wet road driving is difficult.

Regular turning principle is as shown in following figures;

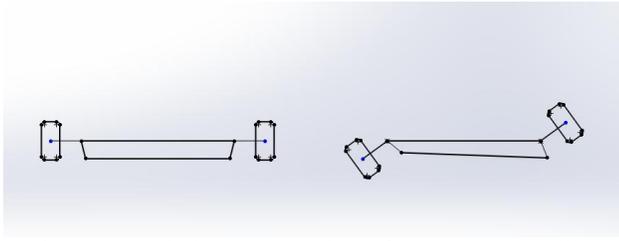


Figure 1: Existing Mechanisms for regular turning (Top View)

To tackle such difficulties of normal steering system, experiments are being conducted on tilt steering system. Tilt steering system provides advantages such as

1. It can provide sharp turning.
2. It has a smaller turning radius.
3. It provides anti-skidding effect.
4. Wet road driving is easier than regular steering system.

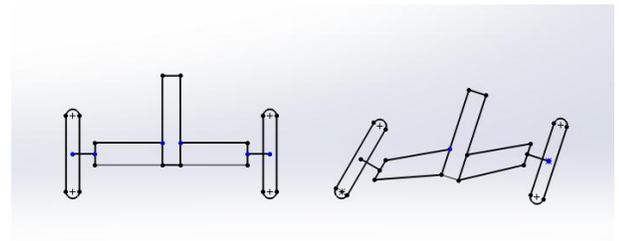


Figure 2: Existing Mechanisms for tilting (Front View)

Though tilting steering system imposes above advantages but it has its own disadvantages too. In case we need sharp turning we can tilt vehicle. But suppose we want to overtake one big vehicle in front of our vehicle at that time tilting may cause our vehicle to take U-shaped sharp turn instead of overtaking the vehicle. So at that time we cannot apply tilting. So it means that both steering systems have their own unique limitations when implemented alone. Hence implementing any one of those systems are not sufficient to improve performance of our vehicle.

IV. FINAL APPROACH

In our project we have combined both regular turning system & tilting system. Due to the combination of both, our vehicle has achieved advantages of both the systems & minimizing the limitations of both. [4] Advantages of our steering system are as follows

- 1: Reduced turning radius causing vehicle to take sharp turn whenever needed.
- 2: Any motion can be given to vehicle (regular turning &/or tilting) according to driver's will.
- 3: high speed of vehicle while taking turn on corners is possible.
- 4: It provides anti-skidding effect
- 5: Wet road driving is easier.

One of the difficult thing that was to be taken into consideration while designing was that while giving one type of motion (Tilting or turning), Another motion should occur. We have designed such system that can allow driver to give any kind of motion without disturbing another.

Concept Animation:

Initially we made CAD model of our concept & checked for its working animation. Our design concept was successfully animated & is as shown in following figures.



Figure 3: Our Mechanisms while running straight



Figure 4: Our Mechanisms while turning

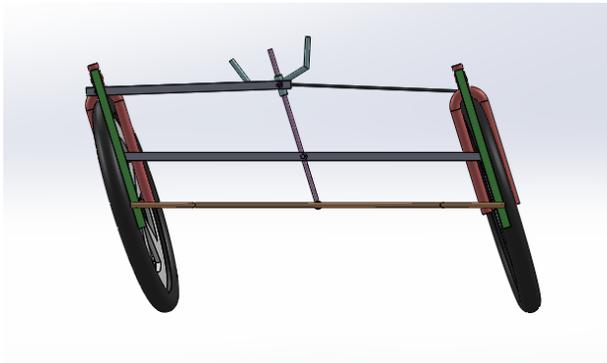


Figure 5: Our Mechanisms while tilting

Concept Implementation:

We have successfully implemented our concept in tricycle. [3] We have manufactured steering mechanism & have attached it to bicycle making few changes in it. Implemented concept is as shown in following pictures.



Figure 6: Final implementation of concept



Figure 7: Final model in turned position



Figure 8: Final model in tilted position

Here tilting is achieved by using driver's weight only. But other means can also be used for tilting like hydraulic & other means. [5]

Here for turning, Ackermann Principle is achieved & for tilting it has Davis mechanism.

Vehicle specification: [6]

| SR. NO. | PARTICULARS | SPECIFICATIONS |
|---------|-----------------------------|-----------------|
| 1 | Vehicle type | 3-wheel Tadpole |
| 2 | Power Transmission | Manual |
| 3 | Mechanical Dimensions (L×W) | 55×40 |
| 4 | Leaning angle | 35 degrees |

Table No. 1

Components Required:

| SR. NO. | Component | Units |
|---------|------------------|-------|
| 1 | Suspensions | 2 |
| 2 | Rose Joints | 8 |
| 3 | Wheels | 3 |
| 4 | Steering Tie Rod | 4 |
| 5 | Thrust bearing | 2 |

Table No. 2

V. CONCLUSION

We have successfully achieved leaning of vehicle up to 35 degrees along with reasonably good performance of trike on road.

The vehicle cornering ability is well tested & gave response as we considered.

Our steering system has been successfully implemented in tricycle & is now able to be implemented in trikes.

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